National CHP Turbine Technology and Regulatory Forum

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CHP Applications

by

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Small Scale "MicroCHP" Applications

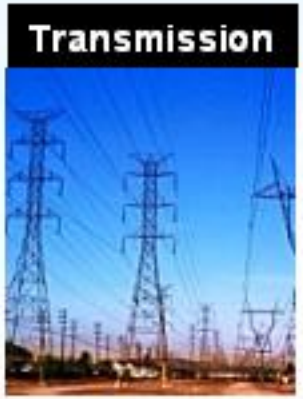
- Capstone Overview
- CHP Value Proposition
- Example Applications
- Rule 21 Certification
- CARB Certification
- CHP Incentives

Capstone: A Big Small Company

- Founded 1988
- 1998 commercial launch
- ISO 9001-2000 UL-certified
- 100% microturbine focused
- 74 USA and foreign patents
- 3rd & 4th generation products
- >2,400 30/60-kW production units sold and shipped
- >3,300,000 cumulative hours of operation worldwide
- Very strong balance sheet

Distributed Generation:

An Excellent Supplement to Centralized Generation



…but for distributed generation to become a true supplement, it must be safe, reliable, clean, simple, flexible and affordable.

Why MicroCHP Makes Sense

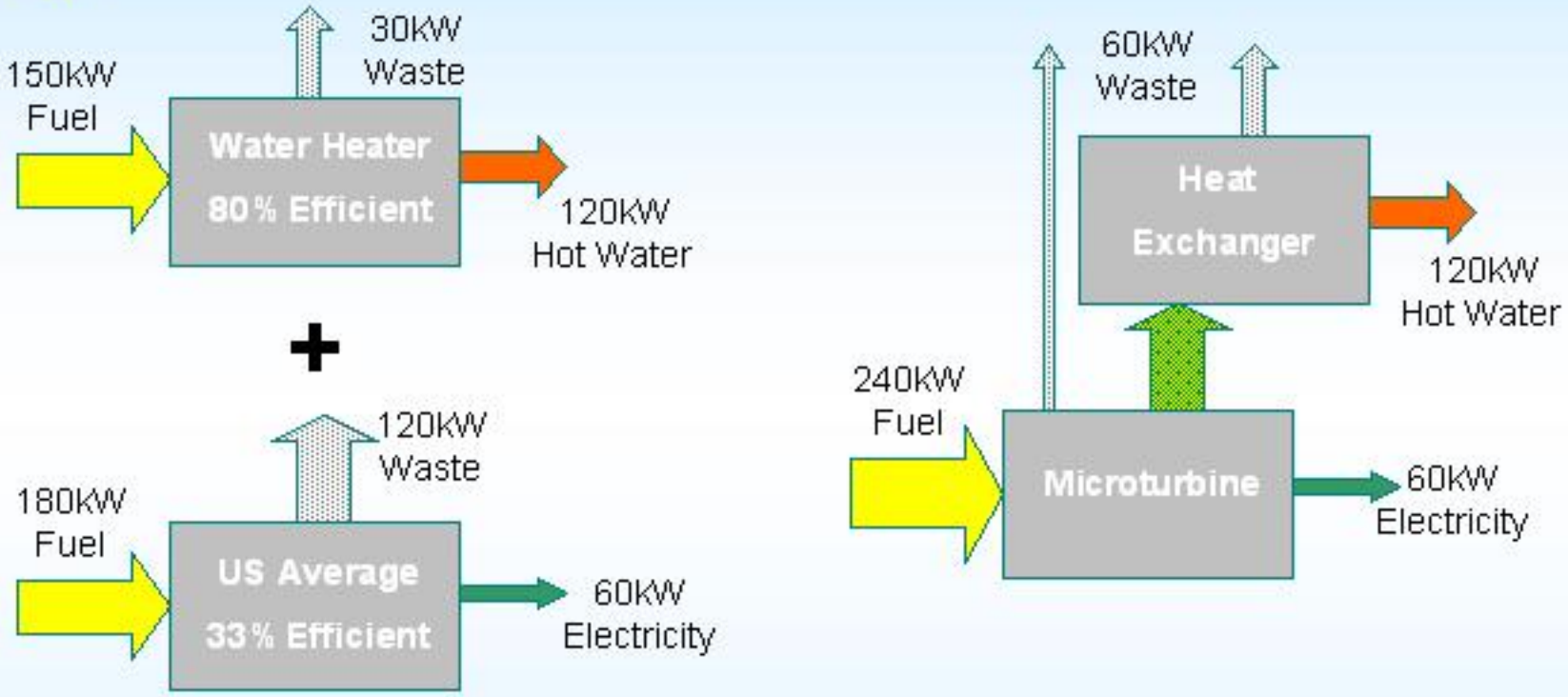
- ✓ ***Clean Emissions*** → Install Anywhere
- ✓ ***Onsite Generation*** → Secure Power
- ✓ ***High Efficiency*** → Economical and
  Good for Environment and
  Conserves Fuel Resources

The MicroCHP Opportunity

Three Major Applications:

- ✓ Direct Exhaust
- ✓ Hot Water
- ✓ Cooling

MicroCHP vs Traditional Systems



Traditional

- 57% Total Efficiency
- 0.2 lb/hr NOx
- 120 lb/hr CO_2

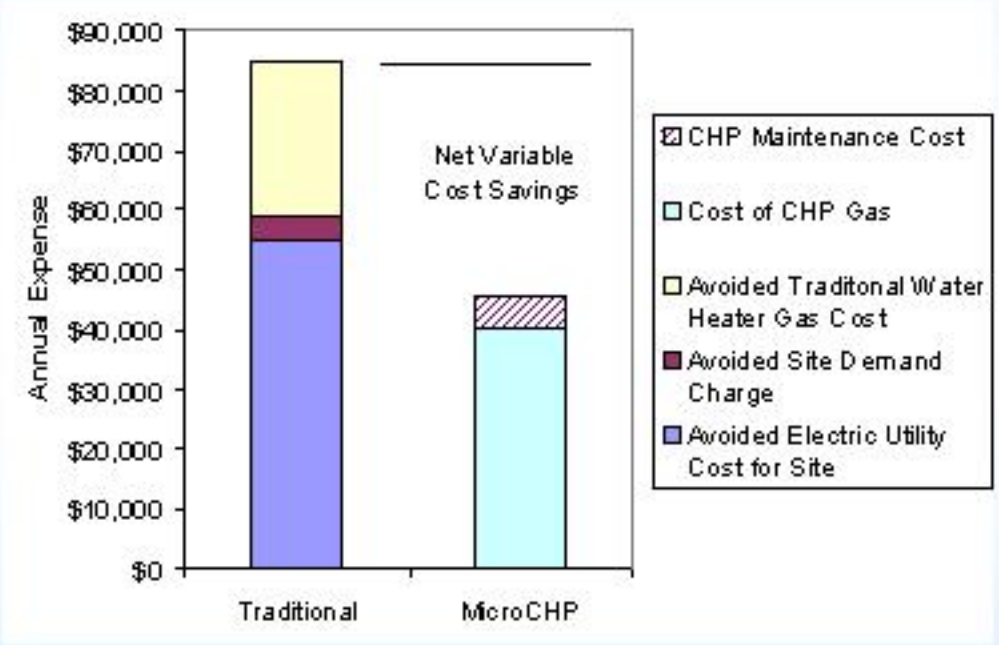
MicroCHP

- 75% Total Efficiency
- 0.02 lb/hr NOx
- 90 lb/hr CO_2

MicroCHP Payback Example

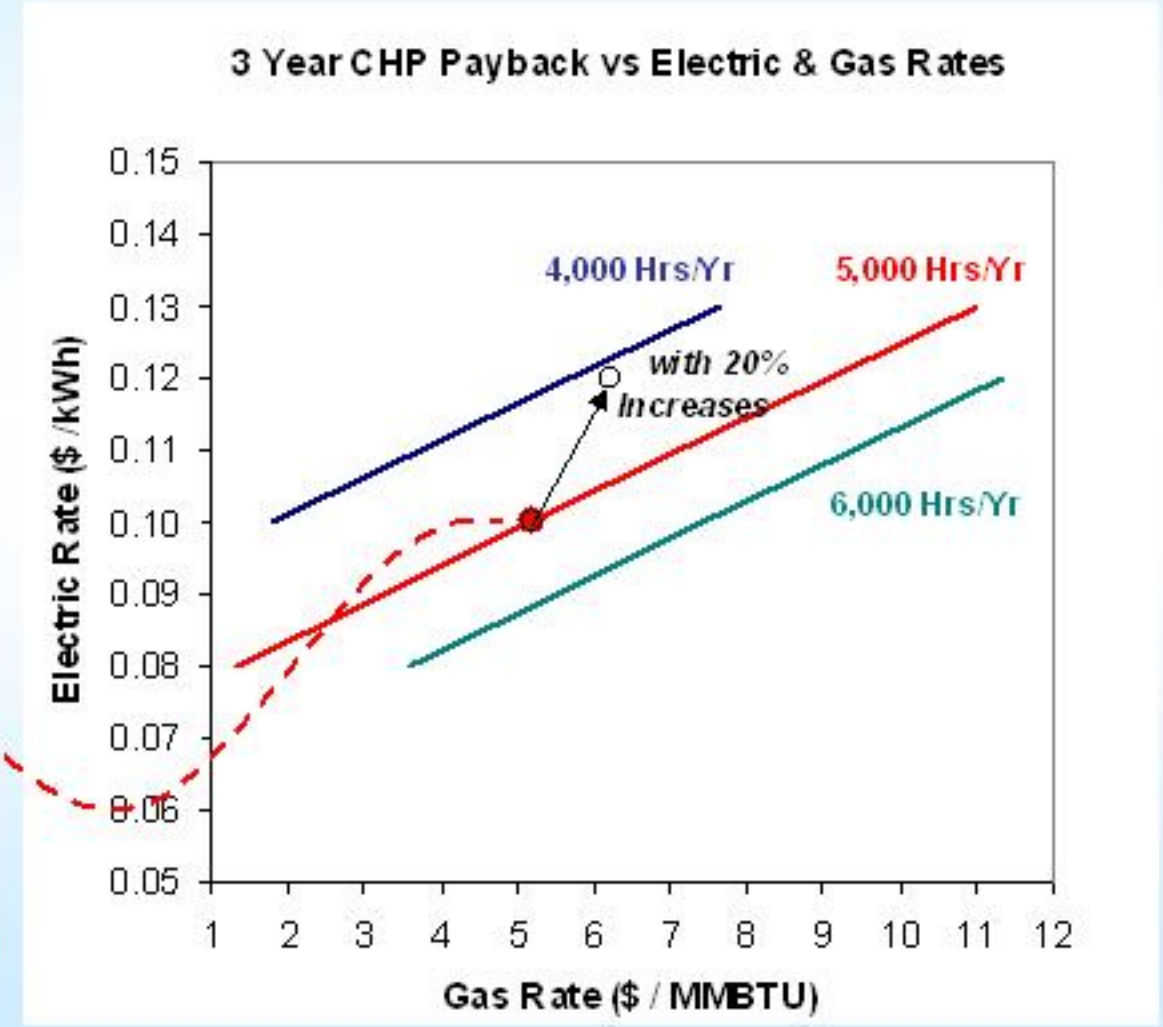
Example CHP Systems with the following Characteristics:

120kW Rated Output
110kW Avg. Electrical Output
220kW Thermal Load
5,000 hr per year Operation
Electric Utility Rates:
$.10 per kWh
$ 5 Demand
Gas Utility Rates:
$5 per MM BTU
$.01 per kWh Maintenance Cost



3 Year Payback !!

MicroCHP Rate Sensitivity



Previous Example

$.10 / kWh

$ 5 / MMBTU

The Direct Approach

- *Uncontaminated exhaust stream*
  - ✓ *No lubricant vapor because there is no oil or other lubricants*
  - ✓ *No oil-fouling of heat exchanger interior or of direct-drying process*
- *Example: Array of 44 C60 (2.6 MWs) at Sanyo Chemical*
  - ✓ *Untreated exhaust is ported directly into chemical driers*
  - ✓ *Dries polymer product*
  - ✓ *Polymer product is used to absorb moisture*
  - ✓ *Oil vapor would render the product useless*
  - ✓ *Only uncontaminated exhaust heat is usable*
  - ✓ *This system has been operating since April '02*

Part of the 44-unit array of C60s at a Sanyo Chemical plant in Japan

Hundreds of MicroCHP Sites Worldwide


Meidensha-Sumitomo OEM CHP unit at a supermarket


96% eff. public Pool CHP, Netherlands


City hall heating, UK


Greenhouse direct heat, UK


OEM CHP 8-pack at a Hospital in Japan


Brick drying, Netherlands


6-pack of C30s preheats inlet water to boilers at California State University Northridge, CA


Nursing Home, NY


City hall heating, CA


Apt. complex, Calgary


Reliant LNG Storage, MN


YMCA heating, IN


Nursing home, IA


Building heating, Brazil


San Diego Navy Base

California State University

Northridge, CA

- Boiler offset
- 6 x Model C30
- 2 Unifin heat exchangers
- 10 am – 6 pm operation

More Combined Cooling/Heating/Power

Heat-driven absorption chilling


Gas utility R&D, Japan


First MicroCCHP: drug store, IN


University, Japan


Office Building, Japan


Office building, Turkey


Office Building, U of MD


Gas utility R&D, CA


Electronics factory, Japan


Office Building, OR


Gas utility education center, CA

Heat-Driven Absorption Chilling

Harbec Plastics Factory:

Rochester, NY

Grid is backup

Primary power: 25 30-kW microturbines

The Harbec BCHP Project

Uses for Waste Heat

Warehouse Heating in Winter

Radiant Floor Heating

17,000' of 1" diameter tubing

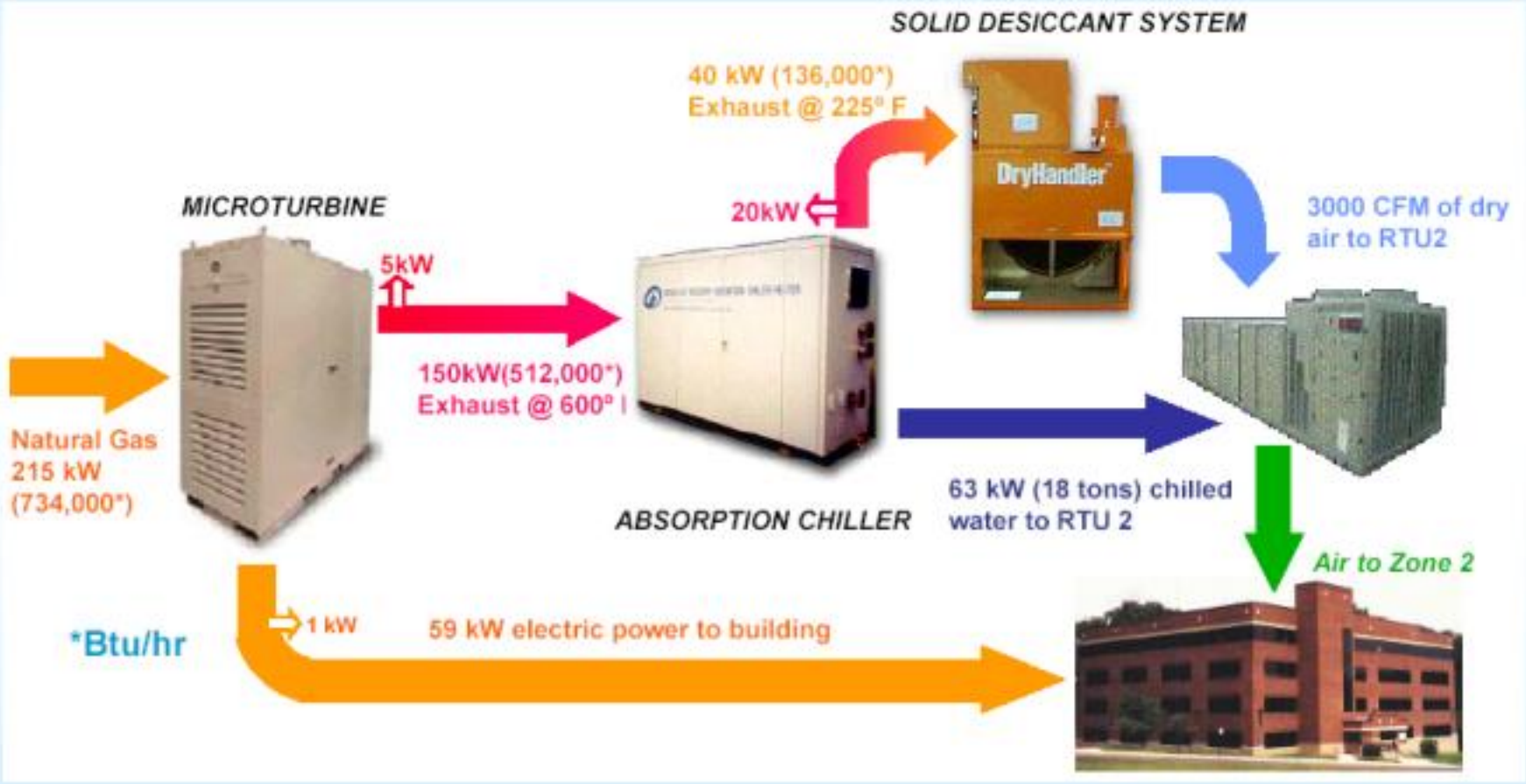
Office HVAC in Summer

Carrier Absorption Chiller

Converts 210° Hot Water to 44°-47° Chilled Water

University of Maryland BCHP Installation

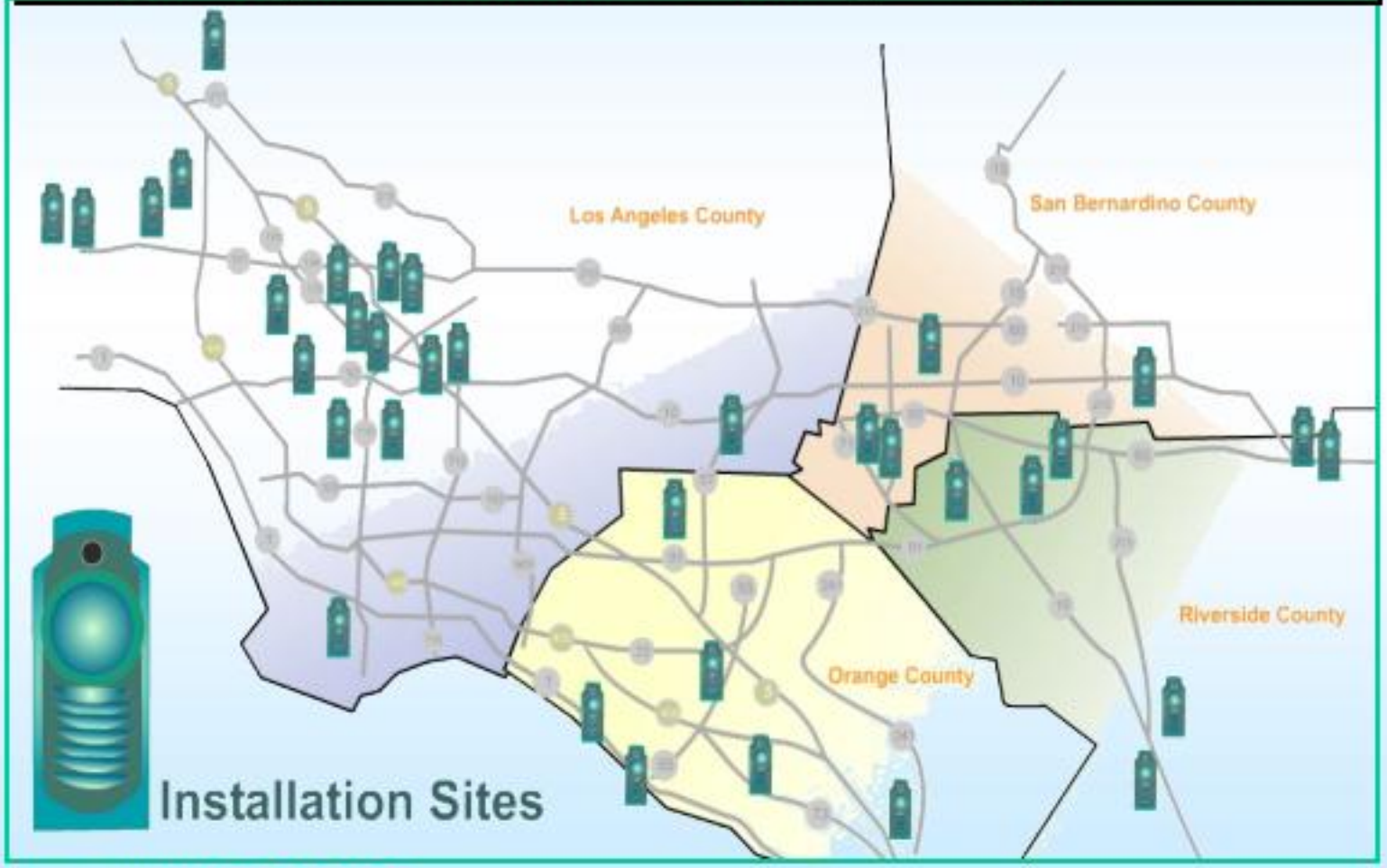
Major BCHP Components



Capstone C60 with Broad Chiller

SCAQMD Capstone Installations

Southern California sites operating Capstone MicroTurbines supplied by the South Coast Air Quality Management District

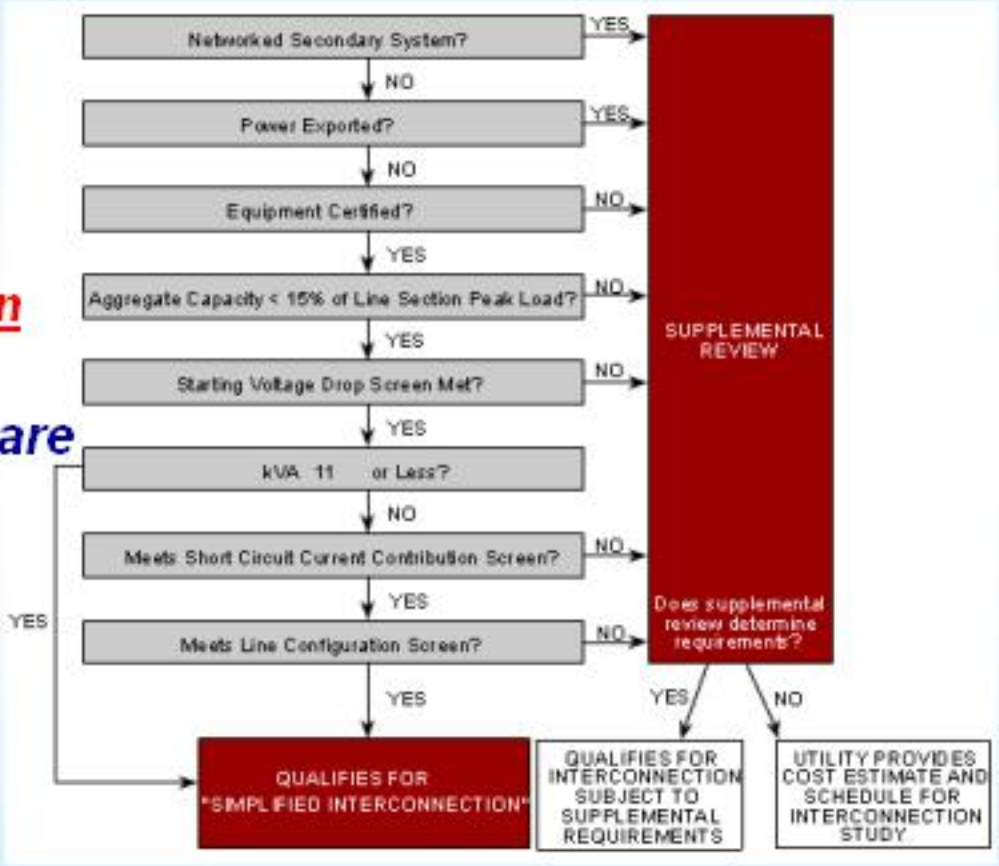


Source: www.apep.uci.edu/aqmd

Rule 21 Interconnection

- *Expedited utility interconnection process*
- *CEC certification*

  www.energy.ca.gov/distgen
- *Capstone microturbines are certified to meet Rule 21 technical requirements*



Existing Utility Interconnections

Partial list of Utility-interconnected installations:

Region	Utility
California	SCE, PG&E, SDG&E, LADWP
New York	ConEd (both radial & network), LIPA, NYSEG, RG&E, NiMO
New England	Northeast Utilities, UI, Green Mountain Power
Atlantic States	PSE&G, PPL, Allegheny, GPU (1st Energy), BG&E
Central States	ComEd, NIPSCO, First Energy

CARB Certification

- *January 1, 2003 CARB initiated new requirements*
  - ✓ *For any installation not covered by local air management districts (e.g. SCAQMD does not cover microturbines)*
  - ✓ *Ref www.arb.ca.gov/energy/dg/dg.htm#DGD for additional information*
- *Output-based standard*
  - ✓ *Several emissions measured*
    - *For example 0.5 lbs/MWh NOx (0.7lbs/MWh for CHP)*
  - ✓ *Emissions weighted*
    - *30% at full power*
    - *50% at three quarters power*
    - *20% at half power*
- *Capstone C60 MicroTurbines are CARB Certified*

CHP Incentives – CA is most active!

- *California Public Utility Commission (PUC)*
  - ✓ **Self-Generation Incentive, *AB970***
    - ***30% rebate on capital, installation & tax for microturbine CHP systems (40% if biogas)***
    - ***PG&E, SCE, SoCalGas, SDG&E***
    - ***Limitations***
      - *Finite pool of funds each program year*
      - *3-yr service agreement required*
      - *Incentive capped at 1 MW per customer per year, maximum 1.5 MW total project size*

- *Los Angeles Dept. of Water & Power*
  - ✓ **Customer Generation Rebate Program**
    - ***Up to $2,000/kW for microturbine CHP systems***

- *Special CHP gas rates*

MicroTurbines